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WEST EUROPE REPORT

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CONTENTS

REPORT ASSESSES FRANCE'S FUTURE IN BIOTECHNOLOGY

Paris INDUSTRIES & TECHNIQUES in French 1 Mar 81 pp 11, 14

[Article: "Biotechnology: It Will Soon Be Too Late"; for related article see JPRS West Europe Report, Science and Technology, JPRS 77736, 2 Apr 81 No 53 pp 12-16]

[Te] A report on biotechnology submitted to the prime minister by Mr Jean-Claude Pelissolo comes down hard on French industry.

To make this industry responsive, the report puts forth 30 recommendations, the first few of which have already brought about the launching of four pilot programs concerning: synthetic fuels, proteins, vegetable seeds, and immunology.

After having for a long time ignored biotechnology, government agencies today are literally fascinated by it. The start of this bolt from the blue was on 12 November 1979. On that day, three "wizards"--Professors Gros, Jacob and Royer--submitted to the president of the Republic their report "Life and Societal Sciences." It created a stir. In February 1980, an initial set of guidelines was defined at a top-level planning meeting in the Elysee. In August, Raymond Barre named Jean-Claude Pelissolo, chief engineer for weaponry and director of electrical and electronics industries, to draw up a general inventory of the problems involved in biotechnological methods and to submit recommendations. This is the report of Jean-Claude Pelissolo, who prepared it under the aegis of Pierre Aigrain, secretary of state for research, submitted to the prime minister in December 1980. Its title: "Biotechnology Tomorrow?"--a question that clearly reflects the author's conservative, guarded and circumspect approach.

On 2 February, a closed ministerial meeting laid down the initial objectives based directly on this report. Four pilot programs were chosen by the government, concerned with immunology, enhanced seeds, proteins and substitute fuels. Meanwhile, the CODIS [Committee for Strategic Industries Development Guidelines], which classes bio-industry a ng its high-priority sectors, has selected its first five industrial partners: the Delbard, Eurosyme, Speichim and Roquette companies and the Institut Pasteur. It has relied heavily on a study conducted by the SEMA [Military and Administrative Equipment Company or Applied Mathematics Research Company] in France, the United States and Japan on bio-industrial methods.

A financial target has now been defined: Between now and 1985, 10 billion francs of industrial investments must be channeled into biotechnological methods, to

increase the business volume of the industries concerned, according to estimates, from 6 to 18 billion francs during this period. These initial measures indicate that the intent is to run fast and hit hard.

However, as is indicated in the Pelissolo report, before engaging in any undertaking in an almost completely new universe, certain preparations are necessary. France has some assets and many weaknesses. Its assets are its high-quality and internationally respected researchers; but its equipment is unfortunately scant and qualified manpower is lacking. Unlike other sectors, it does not lack available funds but rather those who can put them to best possible use.

Other well-known problems are those of compartmentalization, duplication of effort, misunderstandings, sensitivities, jealousies...---a well established French ailment. Biotechnology, more than any other discipline, requires multidiscipline interaction, cooperation and long-haul effort.

French industry, which accounts for 4.5 percent of world bio-industrial annual capacity, is getting a late start not only with respect to the front runners--the Americans and the Japanese--but also with respect to the Germans, the Dutch and even the British. In our country everyone is watching for what the other may do and hesitates to commit himself, not knowing what "secure niche" he will eventually occupy. But the fact is that no one today can tell for sure. Even the most promising approaches, like those of interferon, are already open to question, to doubts.

Nevertheless, the plunge must be taken: An intensive research effort must be undertaken to eliminate dependence upon foreign patents and licenses; competent researchers must be trained in various branches by reorienting tertiary education; more links must be established among universities, research centers and enterprises; data banks must be created; industrial initiative must be stimulated ...

This must all be done in full awareness that the majority of the biotechnological methods that interest the different branches of activity will not emerge for another 20 years. Nevertheless, major sectors are involved, with respect to which J.-C. Pelissolo enumerates specific problems: public health, with regard to pharmaceutics, one of the bright jewels of French industry but a threatened one; the agricultural and food farming industries, in which the research and innovational effort being deployed is too modest (0.1 to 0.2 percent of annual capacity in the food farming industries); the chemical industry, which in 20 years, beyond any doubt, will be a prime domain of biotechnology; energy; treatment of pollution; ore-extraction... By the year 2000, the world market as a whole will undoubtedly represent 400 billion francs, which will be competed for by a few large groups.

With this outlook, bio-industry must be undertaken with a flexible attitude and a mind made up to continually reorient programs as we advance.

From this standpoint, the four pilot projects, aimed at starting up our scientifi-coindustrial machinery, take on major importance. First and foremost, there is the fabrication of carburol: This synthetic fuel is obtained either by the fermentation of sugars (ethanol process), or by enzymatic hydrolysis of cellulose products (acetone-butanol process).

They interest the petrochemicals and chemicals groups substantially, and next the production of proteins for animal feed. To limit our imports of American soya and of manioc (4.5 billion francs in foreign exchange), the production of protein-rich feeds from dairy industry by-products or food farming industry by-products must be developed. The INRA [French National Institute of Agronomic Research] appears to be the logical prime contractor for this project... The vegetable seeds industry looks very promising. It will be to agriculture what the integrated circuits industry is to electronics, as J.-C. Pelissolo sees it. French production in this field is not negligible (4 billion francs, which is 10 percent of world production). But its competitive status has tended to deteriorate over the past several years in the absence of a sufficient innovational effort.

Better links must also be forged between the INRA's remarkable research potential (in genetics and reproduction techniques) and channels of propagation.

Lastly, immunology: An "opportunity" which France appears well placed to seize. Our position is potentially very strong with the Pasteur and Curie institutes, and the universities of Marseilles, Bordeaux, Lille and Lyon. And there exists in France a tradition with respect to vaccines and serums. This position should all the more be exploited in that, according to the most recent studies, new immunological products will, by 1990, represent 40-50 percent of the world market for pharmaceuticals of biological origin (or 20 to 40 billion francs). A careful choice must still be made among modes of industrial application: interferon, vaccines, antibodies, monoclonal cryoglobulins,...? The range of choices is wide, but everything cannot be done at once.

An industrial strategy must also be defined: Will these new approaches be undertaken starting from existing enterprises (the example of electronics and components indicate that innovation is often paralyzed by habits and existing structures), or will entirely new enterprises be created from scratch, like Genetica (created by Rhone-Poulenc) or Transgene (created by Paribas, AGF, Elf, BSN, Air Liquide)?

Will there be room for the PMI [Small and Medium Industries] in these new specialty niches? Undoubtedly, yes. Just as new service, consulting and engineering firms will also make their appearance, similar to those that came into being in data processing. In many respects, this revolution closely resembles, 30 years later, that of the birth of the computer.

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BRIEFS

PROTEINS BY FERMENTATION--The ICI [Imperial Chemical Industries] plant in Billingham (Great Britain), which manufactures proteins for animal feed, has just reached its nominal capacity of 50,000-70,000 tons a year. The plant is located near the refineries that process the gas and oil extracted from the North Sea. It is the only plant in the world that produces proteins by fermentation, on a continuous basis, from a single microorganism. The substrate: a mixture of methanol, mineral salts, ammonia and air. The feat of ICI's technicians lies in having achieved sterile conditions, which are indispensable for this microorganism, in a 1,300-m^3 reactor, and succeeded in maintaining them despite production halts. Although the process is now a fully working one, research continues toward improvements in each of its stages and the building of second-generation plants in the near future. Tests carried out over many years on nonruminant animals (hogs, poultry) have proven innocuousness of this feed additive. [Text] [Paris INDUSTRIES & TECHNIQUES in French 20 Feb 81 p 10] 9238

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USE, TESTING OF COMPOSITE MATERIALS IN AERITALIA PRODUCTS

Rome AVIAZIONE in Italian Feb 81 pp 63-66

[Article by Paolo Jauch, of Aeritalia, Transport Aircraft Group: "Quality Requirements for New Materials and New Aeronautical Technologies"]

[Text] The use of new materials has always been characteristic of the aeronautical industry, and such use has always been accompanied by research and development of appropriate technologies, of production methods useful from time to time to these technologies, arriving, finally, at the necessary definition of different work criteria. Once again, the aeronautical industry is involved in a renovation, and today more than ever, factors such as energy-saving, simplification and improvement of certain preexisting fabrication technologies, adoption of materials that are more suitable in terms of wieght, etc, have conditioned the choices that are being made.

The use of new materials such as the reinforced plastics sees Aeritalia involved in a considerable effort: putting into production structural materials of carbon-resin and various composite materials for civilian use, with strict quality requirements set by the purchaser, with a testing period that is sufficiently short in relation to the production commitment required. The use of composite materials in the form of reinforced plastics requires development or perfecting of the techniques of lamination, of bonding in general and of polymerization in autoclave in particular. Such techniques are being perfected and are becoming differentiated because of the different products that are being worked: unidirectional composites or fabrics as regards the carbon-resin sector; laminates or panels of the sandwich type; different grades of tapes, different kinds of cloths, hybrid panels containing carbon-resin and Kevlar; laminates of Kevlar only; and finally, composites cured at 350°F (177°C) or at 250°F (120°C). Alongside the products mentioned, there is the ad-hoc work being done to perfect the mechanical technologies of drilling, countersinking, turning, cutting, and those of painting and surface protection in general (metalization), and the technologies of inspection of intermediate and finished parts, with special reference to nondestructive testing. In the specific field of quality control that we are discussing, the sector of nondestructive inspection is taking on growing importance, as regards both the continual specialization of the defect standards to be adhered to and the corresponding technical progress (automatic inspection, electronic recording techniques, continuous monitoring, etc).

At the basis of the quality of the product is control of the standards for the installations. Among these we distinguish: autoclaves; furnaces; clean rooms--

Table 1

Material	Storage Temperature	Lifetime
G/E [expansion unknown] preimpregnates	-12°C max	360 days (x)
Fiberglass preimpregnates	+4.5°C max	180 days (xx)
Adhesives for composites	+4.5°C max	180 days (xx)
Adhesive potting	-18°C max	4 months (x)

Notes:
(x) from date of shipment
(xx) from date of receipt

and the requirements for these last-mentioned are especially stringent as regards control of the degree of pollution (the same environmental parameters of purity necessary for the bonding surfaces are required for the preimpregnates in the lamination phase). Equally stringent are control of temperature (19-32°C), of relative humidity (25-70%), of internal overpressure; likewise, the filtration of the intake air is controlled. The use of working instruments with independent powering (internal combustion) or capable of having oils, greases or similar materils come out of them is not permitted. Use of compressed air is permitted if it has no oil or dust. The state of materials on their arrival at the firm is checked for their shipping conditions (dry ice) and for maximum temperature during transport. Internal quality control then has the task of monitoring the conditions of reception (classification and acceptance checks), storage, handling of material to be sent to the production line. The materials intended for polymerization or gluing must meet storage-temperature requirements, as is seen in Table 1 (which is indicative). The preimpregnated or adhesive materials will normally be sealed so as to avoid buildup of humidity. Some of the lifetimes indicated (180 days) can be doubled upon appropriate tests of flow, gel time, short beam shear. Other reuirements have to do with lifetime at various temperatures, as we specify here in an indicative manner: adhesives for composites (350°F) = 168 hours TA [expansion unknown]; fiberglass preimpregnates = 168 hours (5-27°C), 24 hours (27-43°C); G/E preimpregnates (350°F) = 408 hours TA; structural adhesive foams = 240 hours TA. It should be noted that the requirements of the indicative kind differ for the adhesive films, foams, prepregs, liquid adhesives, fillers, and for the various types in each category. Requirements for conservation, anticontamination, cleanliness, etc, are enforced especially for nonmetallic materials in honeycomb form.

The use of honeycombs for sandwich-structure cores calls for many particular requirements for gluing, profile turning (tapering), assembly in general. We mention by way of example: gluing--maximum distance between cell nodes in relation to cell dimensions; possible gelling of the adhesive in the furnace; tapering--corner radius of dorsal fillet; maximum height of bevel (the bevels to be machined are first stabilized with adhesive film + peelable contact layer to be removed after preassembly); stiffening (stabilization)--cell-filling tolerance; checking core filling at full depth (NDI [expansion unknown]); assembly--core-core and core-laminate positioning; core-core and core-laminate transition areas (to avoid defects from voids in the dihedral arrises).

In the lamination and assembly phase, quality control is concerned with adherence to compatibility norms for the preimpregnates (origination from same supplier, belonging to same type/grade/style) and checks on the application of the general fabrication requirements. These requirements have to do with the tolerances on the joints of the preimpregnates (which differ with location and type of material, overlaps, offsets, etc), on placement of adhesive films, on orientation of layers; they have to do with the sequences relative to the intermediate compactings and to the single-phase and multiple-phase stratifications. In general, quality control sets out in tables all the tolerance values as well as the qualitative specifications necessary for laminates, adhesives, honeycomb in the stratification phase, compacting, polymerization in autoclave (with preparation of the vacuum bag). In the phases following bag completion, as is seen, the control operations have to do with: checking for loss of bag tightness; number and position of thermocouples; functioning of thermocouples; spacing of the pieces in the autoclave (6" minimum) for good air flow; connection of thermocouples to recorders; connection of vacuum offtakes to vacuum-pressure gauges (max pressure 0.35 kg/cm^2); proper recording of pressures and temperatures.

The autoclave diagrams and the recordings on the gluing forms will give the following control data: preheating time, cooking time, cooling time, pressure, min and max temperatures, heating and cooling speeds, depressurization times and temperatures. For each autoclave load, test panels are made for the purpose; they are necessary for direct verification of the required characteristics by means of destructive tests. The panels are of the same type as the parts assembled (sandwiches and laminates) and, after being cut, are subjected to the following tests: sandwich panels--long-beam flexure test; flatwise traction test; laminated panels--short-beam test; flexure. The test-piece dimensions are standardized, the positions and characteristics of the load points are preestablished, and standard equipment are normally used. All the mechanical requirements found are compared with the mean and minimum values prescribed. Other determinations have to do with checking of density and checking of thickness of polymerized layers.

Production of any assembly is subordinated to acceptance of the first part produced, which has to meet all the requirements of the specifications and of the applicable fabrication documents. Many checks and recordings are done on this first part: recording of thicknesses measured every 12" (on laminates); noting of reading positions of NDI instruments; number, dimension and frequency (if called for) of the probe used for NDI; results of dimension checks. Checking and acceptance of the assemblies to be polymerized and/or bonded in postcured groups are subordinated to verification of functionality and tolerance of the pieces, by means of verifilm. This type of test, which uses adhesives with two separator films, is aimed at ensuring the exact value and distribution of the connection pressures under the same production parameters (autoclave temperature and pressure); this test, in general use, is proving especially useful today for assemblies of considerable dimensions (5-6 m up to more than 10 m), especially if they are subjected to single-phase curing cycles (co-curing).

The acceptability, repairability and corrective actions permitted on assemblies in composite form have been the subject of evaluation both by the research laboratories (MR&D, QCR&D [expansion unknown]) and by the planning departments. It does not always prove easy to reconcile strict structural-strength requirements (because of configurations aimed at optimizing the weight-to-strength ratio) with the inevita-

ble and sometimes insuperable fabrication restrictions: honeycomb angles, positions and configurations of doublers, stiffener diaphragms inside the cellular blocks, typical angles of deformations in profiles constituting beams (longerons), typical lengthenings on pieces of light alloy which are more deformable thermically, directional distortions of fibers, moldings in sunken areas of mixed laminate-sandwich structures, shifts and deflections of cellular blocks in relation to their height/extension/degree of stabilization, warpage in complex laminates+sandwich structures with section tapered and having honeycombs that are different in weight and extension and are of "full depth" cellular structure, etc.

Defe ts of different kinds, especially as regards assemblies, can be classified as external defects that can be related to the curing process and to bag preparation; external defects of dimensional type relating to geometry, the twisting obtained, etc; internal defects typical of the piece considered and of the geometrical disposition of the material, detectable by nondestructive-inspection (NDI) methods, such as, for example, ultrasonics, X-rays. Some of the requirements listed in the tables (for example, the limits of acceptability for resin leakage, the value for which, in square inches per square foot, is expressed in relation to the nominal thickness of the part cured) are illustrated in tables for testing purposes, for rapid consultation in the shop; analogously, useful reference sta[illegible]s may be preestablished--for example, evaluating starvation of surface porosi[illegible] due to resin poverty and/or to nonuniform distribution of resin (for example, [illegible] ? percent + 1 percent + 2 percent of the extension of a predefined "affected a[illegible]"). A porous surface presents areas with graphite fibers not protected by resin and needing surface fillers, or a puttying which, however, increases the weight of the panel.

The extension of the use of nondestructive tests derives from the necessity of ensuring increasingly stringent quality requirements in a more reliable manner on structures whose soundness of fabrication (defects during and at the end of the cycle), as well as functional behavior, it is always necessary to verify. At present, the working phase of the industries involved in launching the production of G/E parts and derivatives requires the maximum effort in production controls. The parameters that come into play in this part of the approval-testing work are: the geometry of the part and its total thicknesses; type of construction (flat/curved panels, full-sandwich structures of deep depth, laminates); type of material (carbon-resin of various thicknesses styles/grades used; phenolic honeycombs, honeycombs of variable-density reinforced fiberglass, adhesives, etc); type of fabrication cycle (all precured, all co-cured, part precured and part co-cured); inspection speed required; degree of automation possible and/or required; necessity or nonnecessity of of recording the result. From the operational point of view, the following are of concern: accessibility to the part or surface to be checked; the roughness of the surface; any connecting liquid that may be involved; degree of precision required of the NDI method (instrument capability)--normally, vis-a-vis a certain defectiveness value set for production purposes--for example, 1/2" of a typical dimension--a static detection capacity that is quite a bit lower is required of the instrument; it may be fixed in the calibration phase at 1/4" dimension, for example. For the carbon-resins, in addition to the indispensable visual check for detecting surface defects, among which is the aforementioned starvation, the following methods are classified: ultrasonic, X-rays. Ultrasonics are used, both on laminates and on sandwiches, to detect ungluings, delaminations, voids, gaseous presences in general, and lenticular inclusions associated with interfaces between materials of different acoustical impedance. X-rays are used for defect

H/C [honeycomb sandwich] H/C and H/C-laminate connections, to discover deficiencies (porosity) or excesses of resin, to inspect in the radii and curved areas of laminates for bridges and local separation; to discover cracks in laminates; to inspect cellular blanks in situ in the final assemblies for the tolerances established for them (gaps in the joints, cells broken/distorted, etc). Ultrasonics are classified, for practical purposes, in the following categories: low frequency (bond testers), 20 kHz to 500 kHz; medium frequency, 0.5 - 1 MHz; high frequency, 1 - 10 MHz (depending on thicknesses).

The third category can be considered limited to laboratory use on laminated material, and is for evaluating porosity and overall absorption in relation to thickness; it has likewise been used in connection with the reflective technique with reflector and as a simple thickness gauge for measuring depth of delaminations. The second category is used in the technique of inspection by transmission with collimated beam through water jets or squirters (TTUMCC); and the first category is that typical one of manual instruments that employ various techniques and different types of probes. We mention the principal methods in this category: impedance-resonance (Fokker Bond Tester); variable-frequency resonance (210 Bond Tester); pulse-echo reflection (Bondicator). Other methods in this category are analogous to the three mentioned and are applied with similar apparatuses (Harmonic Bond Tester; Acoustic Flaw Detector). X-rays are used to advantage in the cases referred to, always with the technique of "soft" radiation at low kV. The use of X-rays in low-kV intervals (10-25 kV) makes it possible, in practice, not to "perforate" low-density materials easily but to succeed in evaluating moderate variations of density (to be related to defects, internal irregularities, etc) by using small variations in impulse voltage (1 kV). In the case of inspection of glued joints, the test is applicable only if the adhesive is sufficiently opaque (and this is true for graphite-metal joints also). Radiography, which is normally not suited for detection of delaminations or interruptions between ply and ply, can also discover defects of this kind and help in delimiting delaminations at the edges (holes, edged panels) by the use of radiopaque filtering liquids (TBE [tetrabromoethane] or DIB [diiodobutane] and similar). This technique has been used extensively in evaluations of the quality of the drill bits and countersinkers used on carbon-resins, Kevlar, fiberglass-C/E and fiberglass-Kevlar composites.

The radiographic technique proves useful also for discovering internal ruptures from impact. In recent times, the use of composites on aircraft parts subjected to impact of foreign bodies has made necessary, along with the hybridization of laminates by external use of one or more plies of Kevlar (PRD 49, du Pont), the performance of tests for evaluation of the degree of internal damage (use of NDI). This type of damage (Impact Damage) is greatly feared because of its effects and because it is not easy to detect from outside the aircraft. Because impact damage is often transmitted to the inside of the panel (low e- e) and causes ruptures of fibers, is strongly feared, even more than delamin...tions (separations of plies), whose influence on fatigue phenomena seems minor. Finally, the usual penetrating liquids (dyes, fluorescents) have been tried for detecting cracks, porosity appearing on the surface, delaminations on the edges of C/E laminates. The good results obtainable are offset by the possible pollution from the products applied but not removed, excessively porous surfaces may not prove, upon close inspection, to be in a condition to be completely renewed. Numerous efforts are under way today to evaluate the deterioration of carbon-resins due to infiltration of water from the edges and from the surfaces (steam is capable of reducing the fiber-matrix bonds.

especially in conditions of variable pressure, as happens in ground/flight cycles). Possible kiln-drying cycles are under study also.

The technique of dielectric cure-monitoring, for control of the polymerization cycle, is in the experimentation phase. The following parts of this cycle can be distinguished: molecular-combination phase, with formation of a polymerizable intermediate (liquid state); startup of polymerization; formation of polymeric chains of three-dimensional extension (gel point); the composite functions as a dielectric in a capacitor. The properties of the resin, which are variable during curing, are checked by means of measurements of the dielectric constant (capacitance = degree of alignment of the molecular dipoles in relation to the electrical field) and the dissipation (in relation to an alternating-current electrical field). Dissipation is connected with the variation of resin viscosity. Interlaminar porosity proves to be of great interest on account of its connection with mechanical properties (a reduction of strength at the rate of 7 percent for each percent of void content, up to 4 percent, is assumed). Since the interval from 0 to 2 percent is critical for primary structures, measurement precision higher than 0.5 percent is required. For this purpose, the ultrasonic C-scan can be used. Resin content is measured with acid digestion only if the variation of it on the panel is not required. Even if such a percentage variation does not have an impact on mechanical strength analogous to void content, it can be measured with NDI methods. Normal radiography or thermal neutron radiography can be used--the latter technique being more accurate than the former, but still expensive at present. Eddy currents can also be used for checking resin content. It is obvious that this content also gives the measurement of the fiber-resin ratio. An analogous correlation does not seem to exist between conductance (IX) and void content. Generally speaking, the precision levels achievable by means of electrical measurements may in future supplant the more expensive methods of chemical analysis by laboratories.

The scanner of a water-jet ultrasonic apparatus for automatic inspection (TTUWCC) is useful in particular for structures based on sandwich panels with thin skins of carbon-resin and phenolic honeycomb. This type of panel is typical of all of Aeritalia's production for use on the B767 aircraft. The TTU proves advantageous for those sandwiches which are not to be immersed in water for the ultrasonic inspection. Ease of use and absence of coupling liquids are some of the advantages of a low-frequency ultrasonic apparatus known as Bondicator, used both on laminated panels and on sandwiches. The acoustic type of bond-tester (1-8 kHz), with variable frequency, equipped with a single transducer, it has operating and sensitivity characteristics analogous to the preceding instrument. The radiogenic tubes used for the carbon-resins are of the beryllium-window type for the special wavelength-distribution requirements for use on the carbon-resins.

The process called "flame spray" consists in spraying a finely powdered molten metal (Al on the carbon-resins) on a surface to obtain a coating that has particular characteristics; among them are resistance to corrosion and, in the case of the composites, protection against atmospheric electrical discharges. Indeed, the layer of aluminum produces on the exposed surfaces tracks that are highly and continuously conductive. The metal (pure or in alloy) is melted by means of an oxyacetylene flame and is atomized with compressed air. The air cools the particles, which anchor on the surface, where they reach low temperature (60-70°C); no damage is done to the piece, and the entire process is considered cold-working. The coating proves harder, shinier and more porous than the original metal; the particles are

anchored to one another and to the surface, where they interlock by mechanical impact. Adequate surface preparations (light sanding) make it possible to obtain sufficient compaction and adherence values.

The need to improve the fatigue-resistance characteristics of riveted joints has led to adoption of the new type of fastener called the brile rivet. The estimated increment is 30 percent. It is an element with a mixed cylindrical-conical head with an angle of 120°, made of solubilized and aged 7050 light alloy, with anodized surface. Acoustical emission is a technology already known and applied with growing success to nondestructive under-load monitoring of many types of metallic structures in service (civil, industrial, etc). It has also proven a valuble investigative instrument in the field of nondestructive testing as applied, for carbon-resins, to monitoring in the laboratory and, as for metallic structures, in flight. In the carbon-resins, the dynamics of crack propagation, in relation to the possible or real starting points, are quite variable and rather unpredictable. Ruptures can start far from the points of maximum stress because of phenomena of propagation and transmission of internal tensions that follow laws that are not simple and are in any case dependent on thicknesses, types of material, stratification sequence, width and length of test piece, types and speed of application of loads.

Drilling in carbon-resin laminates has presented peculiarities vis-a-vis drilling in light alloys because of: the necessity of avoiding delaminations; necessity of avoiding ruptures of fibers in relation to the matrix; necessity of avoiding local overheating (120°C or 175°C, depending on the resin system); necessity of ensuring the required degree of roughness and cylindricity of the hole.

For this purpose, the studies and tests done in the preproduction phase have developed bits (presently being patented) with the following characteristics: cutting-edge profile of special design for maximum reduction of axial force; tungsten-carbide material; top rake = 0° or negative; bottom rake = 6° to 7°; very high RPM (up to 18,000 RPM as against 4,500 RPM for the light alloys); use of special suction equipment, coupled to the bit, for fast elimination of the material removed, which is a powder of very fine granulometry (down to a minimum of 2 microns). The Al/carbon-resin combination requires the drilling parameters typical of Al (speed and tool), but with tungsten-carbide material. Analogously, countersinkers with diamond surface will be used for the roughing-out, and with tungsten-carbide surface for the finishing. The problem of the cutting and rectilinear edging has been solved with the use of diamond-surfaced discs or diamond-surfaced belts; for non-rectilinear edge-milling or molding, diamond-surfaced burrs with discharge outlets for removal of the graphite powder are used also. In this case, peripheral speeds of 2,500-4,000 m/min diamond-surfaced disc) or 400 m/min (diamond-surfaced belts) are used. When reciprocal saws (with diamond blades) are used, a cutting speed equivalent to 2,500 RPM will be set. The small-diameter diamond-surfaced burrs mentioned will also run at 400 to 1,200 RPM peripheral speed for edging. In the case of mechanical working of glass-resin, reference is made to analogous diamond-surfaced tools or to tools with tungsten-carbide scales on their surfaces.

A different development has occurred for the same techniques on Kevlar (PRD 49 du Pont) laminates or on hybrid laminates containing Kevlar (external protection layers). The enormous shear strength of Kevlar and its tendency toward stripping are its principal differences from carbon-resin from the cutting/drilling point of

view. Low drilling speeds (600-2,000 RPM) are used, because of Kevlar's tendency to burn. In this case, the tool is fitted with a helical bit (of HSS material), with leg guided in a support for the purpose (under patent). The drilling times are longer because of the lower speeds on Kevlar, and this requires appropriate cooling. Finally, cutting of Kevlar requires a circular saw with pitch of 8 teeth per inch, 3-mm blade with offset teeth, and peripheral speed of 750 m/min. As one sees, different and special techniques are required for each composite material--techiques that have called for appropriate development to perfect them and to optimize the product-quality/tool-life/work-time/preparation-time ratio, all of this producing a considerable impact by the ecological factor in the shop (elimination of dusts, handling problems) that is typical of plastic-matrix composite materials.

Current shot-peening technique is being extended, on the B767, to the inside surfaces of some holes with diameter > 1.8". In this case the operational technique, with assembly of the pieces directly in the construction bay, is proving innovative. "Pultrusion,"in the carbon-resins field, corresponds to the extrusion technology used to obtain profiles of metal. The material supply for the system is composed of fibers coming off spindles; the strips, first impregnated with resin, are introduced into the die for alinement and shaping and go off to form the section (T, I, etc) after passing through a continuous microwave oven. Pultrusion represents the most recent attempt to achieve the continuous forming of a composite material with the desired structural element obtained directly. Anodic oxidation by phosphoric acid is a new electrochemical surface-treatment procedure that is gradually taking the place of the traditional sulfur-chromic processes, especially for the metal-to-metal bondings of the B767 aircraft. The increase in structural gluing and (at least as a tendency) the extension of it to primary structures require the oxides to have improved characteristics (high adhesion and cohesion, environmental stability) that are obtainable and verifiable by processes of proven reliability and secure inspectability. The oxidation in question, accompanied by rigorous checking of the parameters (temperature, concentration, amperage), does indeed ensure a reliable constant of quality obtainable by means of certain simplifications and with simple visual checks (change of color in polarized light).

The totality of the technologies outlined--regarding the activities in fabrication of reinforced plastics; those of control, nondestructive control in particular; those of riveting, of chemical and mechanical surface coating and treatment; those of mechanical working on composites; and the others referred to--represent a partial picture of the entirely or partly innovative technologies that Aeritalia is committed to developing, particularly for the new materials and for the B767 aircraft. In this regard we mention the advanced composite applications on this aircraft (a good part of which are under Aeritalia's competence): inboard spoilers (G/E); outboard spoilers (G/E); inboard ailerons (G/E); outboard ailerons (G/E); elevators (G/E); rudder (G/E); engine cowlings (G/E); wing-fuselage fairings (hybrids with Kevlar); wing trailing-edge fixed panels (hybrid with Kevlar); TE stabilizer (hybrid with Kevlar); vertical-fin TE fixed panels (hybrid with Kevlar); extremities of engine-pylon fairings (Kevlar); wing tips (Kevlar); fin tip (Kevlar); stabilizer tips (Kevlar); wedge on TE of outboard flaps (Kevlar); nose gear doors (hybrid with Kevlar); main landing-gear doors (hybrid with Kevlar). The technological development efforts necessary have involved the areas of study and experimentation, process, perfecting of procedures and layout for fabrication, qualification of installations and personnel; and the numerous complete parts made in Aeritalia (spoilers, ailerons, rudder sections, etc), together with vast research ac-

tivity (MR&D, QCR&D) on details and subcomponents, have accompanied and are presently accompanying the effort toward assembly-line producibility and industrialization of these fabrication activities. Other sectors are under study for cutting techniques (use of water-jets in production), assembly techniques (bimetal rivets, titanium rivets, etc), molding techniques (tools which are themselves made of undeformable reinforced composite material). Alongside these are all the laboratory materials, involving the procedures for testing preimpregnates and adhesives upon reception, the procedures for chemical, physical and mechanical testing during the fabrication process, for testing new products and checking the qualifications of new suppliers and/or different resin systems (in this field, the work to determine the characteristics of new resins, new controlled-flow preimpregnates, and the corresponding fabrication specifications is in full swing). An approximate idea of the quantities of carbon-resins that will be used for the Aeritalia parts on the B767 is about 800 kg per aircraft, for cloths and tapes. For Kevlar, the corresponding value would be about 80 kg per aircraft. But the interest of the new materials is not limited to that aircraft; it extends today to the new aircraft which Aeritalia is designing and to the research programs that apply to the sector.

11267
CSO: 3102/184

BRIEFS

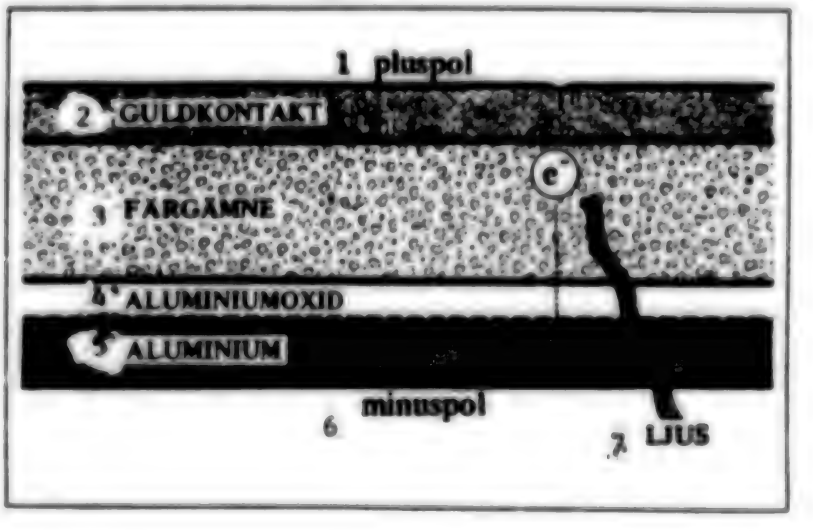
CHEMICAL FEEDSTOCKS FROM COAL--Under the pressure of oil prices, research on coal refining, especially for use in the chemical industry, has received new impetus in the years 1978/1979. It has thus become necessary to bring up-to-date the study published in 1975 in the "Chemistry + Progress" series of the VCI [Chemical Industry Association] and entitled: "Ensuring Raw Material Supplies Through Coal Refining." The result is now being published as No. 1/1981 of the series published by the Chemical Industry Association. Members of the VCI's "coal refining" working group, or rather the enterprises which they represent, have reviewed the old brochure and brought it up-to-date. The essential statements contained in the former study have been retained, as they are still entirely valid today. The upshot of the conclusions of the working group is that, under the present conditions, the processes available are still not operating economically; in the medium and long term, however, further development of the processes based on existing technologies would make it possible to use coal economically as a raw material for the chemical industry since, in the long run, coal is the only alternative to oil. [Text] [Duesseldorf EUROPA CHEMIE in German 4/81 p 55] 9294

CSO: 3102/227

NEW PHOTOVOLTAIC CELL: SIMPLE, PROFITABLE

Stockholm NY TEKNIK in Swedish 12 Mar 81 p 21

[Text] The degree of efficiency of a new type of photo cell is only three per thousand. Researchers at Cambridge University in England who discovered the method do not know why the cell functions. They know, however, that it gives cheap electricity in spite of having very poor efficiency. It is also cheap to manufacture. The newly built photocell is very simply constructed. A thin layer of aluminum is separated from an equally thin layer of organic coloring agent by a still thinner layer of aluminum oxide (Al_2O_3). Light shines through the translucent layers of aluminum and aluminum oxide. The photons are absorbed by the coloring agent, the atoms of which are excited and give off electrons. The electrons are carried by a complicated process through the oxide layer and create a voltage across the oxide. Researchers do not know exactly how it all happens. In practical tests, however, they have seen how the cell behaves with different chemical combinations of the coloring agent. The researchers have also decided which immersion will be used to facilitate the movement of electrons through the oxide layer. Efficiency during the latest experiments reached 0.31 percent, according to the NEW SCIENTIST. This is insignificant compared with the nearly 20 percent for silicon photocells. The new photocell can be cheap to manufacture. Despite the low efficiency it can therefore still be profitable. As researchers begin to learn how the cell functions, they also expect to make a more effective cell. They will probably find a better combination of color agents, dipping, and oxide.



Key:

1. Positive element
2. Gold terminal
3. Coloring agent
4. Aluminum oxide
5. Aluminum
6. Negative element
7. Light

9287
CSO: 3102/225

MORE EFFICIENT POLYCRYSTALLINE SOLAR CELL DEVELOPED

Frankfurt/Main FRANKFURTER ALLGEMEINE in German 8 Apr 81 p 32

[Article signed H.Z.: "More Power From Silicium Nitride Solar Cells; Polycrystalline Material Also Found More Efficient"]

[Text] A new type of solar cell, more efficient than conventional cells in transforming sunlight into electric current, has been developed by R. Hezel of the Institute for Material Sciences of the Erlangen-Nuernberg University. These new solar cells are also easier to manufacture and, therefore, should also be cheaper. While ordinary commercial solar cells made of monocrystalline silicium have an efficiency of 13-14 percent, an electric current recovery of 16 percent has already been achieved with the new process, and a further increase to 19 percent seems possible in the near future. With polycrystalline silicium, efficiency could be increased from 9-10 percent to 13 percent. This new solar cell could represent an important step in the economic exploitation of solar energy.

Considerable efforts are now being made to reduce the cost of solar cells. One way consists in using a polycrystalline or an amorphous material instead of expensive monocrystalline silicium wafers, like those used for integrated microcircuits. This is cheaper, but it is also less efficient, so that the cost reduction is offset, entirely or in part, by the fact that larger surfaces are required. To produce conventional silicium solar cells, the electric characteristics of the material must be modified so as to create a boundary layer between the domains of positive and negative charge carriers ("pn-transition"). For this purpose, foreign substances, phosphorus for instance, are allowed to diffuse into the silicium at temperatures of over 850°C. However, temperatures that high will damage the crystal lattice, and reduce efficiency.

In the process developed by Hezel, the material is spared such high temperatures. In addition, fewer operations are required. Fundamentally, this new solar cell is made in a different way. The silicium is coated with a thin oxide layer, 1.2-1.6 nanometers thick, on which an 80-nanometer thick layer of silicium nitride is applied. Permanent positive charges are thus created at the boundary layer; they are of decisive importance in the ability of the solar cell to perform. When a pair of positive and negative

charge carriers are generated by the light, they are separated in the electrical field. The electrons wander through the oxyde layer and into the metallic electrodes which are imbedded in the silicium nitride. A current can then flow. The electric tension of these cells is higher than that of the usual cells.

The silicium nitride forms an impassable layer with an extremely high mechanical and chemical resistance. This layer is precipitated on the silicium wafer by a chemical reaction involving silane and ammonia. In this process, atomic hydrogen is produced, and it neutralizes any disturbing defect in the crystal. This improves efficiency. It is especially advantageous in the case of a polycrystalline material in which part of the charge carriers are intercepted at the crystallite boundary and are thus lost.

9294
CSO: 3102/227

UNDERGROUND COAL GASIFICATION TESTS TO BEGIN

Duesseldorf HANDELSBLATT in German 13/14 Mar 81 p 14

[Article: "Coal Gasification Planned Underground"]

[Text] Freyming-Merlebach--On the grounds of the mine deactivated in 1973 in Faulquemont (Falkenberg) of the Lorraine mining company Houilleres du Bassin de Lorraine (HBL) underground coal gasification should begin at the end of this year after initial test drillings at the beginning of 1980. Provisionally three different drillings are planned outside of inhabited areas at a depth of about 1,000 meters.

The experiments are being conducted by the Study Group for Underground Gasification, a consortium comprised of Chimie de France, Gaz de France, the French Petroleum Institute and the Bureau of Geological and Mining Research.

Faulquemont is the second location where the French want to try out this relatively little developed technology. Underground coal deposits which can not be exploited economically with conventional excavation machinery should be used for this.

The principle: two drillings will be made in the earth at set distances from each other (up to a maximum of 100 m from each other). Under high pressure oxygen is blown into the first borehole which ignites the coal deposit underground and draws off the gases which develop through the other borehole. A preparation and processing unit for the individual gas components is attached.

The first experiments on underground gasification took place in Bruay-en-Artois, the drilling being done from the bottom of the mine toward the outside. Pressures up to 600 bar were used; it is planned to go up to 1,000 bar. According to the French Ministry of Industry the first experiments "have gone rather positively," so that further experiments can follow.

In view of the worldwide increase in energy prices, the French are attempting to turn to economic advantage their estimated total of 2 billion tons of coal reserves, a large portion of which cannot be excavated under current conditions. The first drillings for subsequent gasification are components of an intially modest F 30 million gasification program (DM 13.5 million), which was 40 percent subsidized by the European community and which will soon run out. A second

gasification program was added this year with a volume of F 125 million (DM 56.3 million), likewise with funds from the EC coffers in Brussels.

All coal research activities, which, among other things, concern the use of coal in power plants for long-distance heating, in cement manufacture, and also for above-ground coal gasification in large-scale installations, have been managed since mid-December by an advisory group formed by Minister for the Interior Andre Giraud, with the title Codetec (Consulting Committee for the Development of Technologies for the Use of Coal). The entire coal research activities are components of a five-year plan initiated in March of 1980 with a volume of F 250 million (DM 112 million). Up to now F 70 million (DM 31.5 million) of this have been used.

With the state French mining company, Charbonnages de France (Paris), which consists of Houilleres du Bassin du Nord et du Pas-de Calais, Houilleres du Bassin du Centre et du Midi, coal research activities are conducted by Cerchar (Center for the Study and Research of the Coal Mines of France).

Of the approximately 20 million tons of French output in the last year just half of the output, 10 million tons, comes from Lorraine, the remainder from other districts. The total consumption of coal in France amounted in 1980 to about 50 million tons, of which the remaining 30 million tons had to be imported.

9485
CSO: 3102/209

BRIEFS

FLUIDIZED-BED COMBUSTION PROJECT--In Grimethorpe (Northern England) a fluidized-bed combustion unit was put into operation which was built with international assistance at a cost of $20 \cdot 10^6$ pounds. The unit was designed in particular to investigate the potential of a new type of coal-fired boiler developed by the National Coal Board (NCB). The project is financed in the framework of the International Energy Agency in equal parts by the United States, the FRG and Great Britain. After 4 years of intensive development and construction by the three countries involved, the experimental unit was subjected to a series of start-up tests which ended with a test under full load. For the coming 3 years a program aimed at gathering information and operational experience for the commercial use of fluidized-bed combustion in coal power plants is planned. [Text] [Duesseldorf BRENNSTOFF-WAERME-KRAFT in German Feb 81 p 43] 9485

COAL GASIFICATION PROJECT--Gelsenberg AG, a subsidiary of German BP AG and the Saarbergwerke AG, Saarland, owned by the FRG and the Saarland, want to work together in the area of coal gasification. Saarbruecken will be the joint headquarters of the "GfK Company for Coal Gasification, GmbH." The cooperation extends especially to the following areas: a) Operation of the pilot unit in the engineering center established at the Saarberg plants at the Voelkingen-Fuerstenhausen station for coal gasification according to the Saarberg process and conduct of the experimental program. b) Planning, construction and operation of a large engineering demonstration unit to the extent that this is justified by research results and can be operated economically. In this connection, in the context of a planning study promoted by the federal minister for research and engineering the prerequisites are being studied (coal throughput $2 \cdot 10^6$ t/a). c) Evaluation of the know-how obtained domestically and in foreign countries. [Text] [Duesseldorf BRENNSTOFF-WAERME-KRAFT in German Feb 81 p 43] 9485

CSO: 3102/209

PULSATING-CURRENT ELECTROLYTIC PLATING SAVES ENERGY

Paris L'USINE NOUVELLE in French 5 March 81 pp 105-107

[Article by Pierre Laperrousaz: "Materials Saved Thanks to Pulsating Current"]

[Text] Some speak of a new era in electroplating. In any case, even if users are still few, pulsating-current electrolytic plating is one of the favorite topics of conversation among specialists.

The literature offers a wide array of articles on the subject and some meetings, such as the one in Boston last year, are entirely dedicated to the subject. It is true that the pulsating-current technology promises much: higher rate of deposition, more even distribution, higher hardness and density, finer granularity, lower hydrogen inclusion, etc.

This is obviously enough to arouse the interest of professionals, particularly those whose jobs are in the deposition of precious metals and who are always looking for ways to save on materials who are becoming ever more expensive. It is in fact among these groups that the first examples of application of pulsating currents can be found.

These are in truth not entirely new, at any rate in their principle. If they are reappearing today in front-line news, it is because of the recent development of power electronics.

Generators Will Soon be Delivering Peak Currents of 1000 Amps

Pulsating-current electrolytic techniques consist of using, instead of direct current, a square-wave current source with a predetermined pulse-width and frequency. In other words, the current only goes through the bath for a fraction of time. It can even be reversed, the cathode momentarily becoming the anode. The most recent pulse generators can produce almost an infinity of different wave-shapes (or current profile) with maximum intensity (peak current) up to 500 amps. Rumors even speak of soon-to-be-available generators capable of delivering peak currents of 1000 amps. The current wave-shape can be adjusted by varying the wavelength (continuously or in steps depending upon the equipment), the frequency, and the amplitude. Some generators such as the Polar built by Techno-Instruments Ltd and distributed in France by Gemdata, and placed as an interface between the rectifier and the work cell, allow this adjustment to be made in an anode cycle as well as a cathode cycle. They also offer the possibility of generating pulse trains.

The action of pulsating currents is generally explained by the disappearance of the parasitic ion layer provided by the dissociation of water and conductive salts present in the bath and which accumulate around the cathode. This layer tends to prevent the passage of metal ions. The deposition thus obtained is rougher, more porous, and contains inclusions. By periodically cutting off the current, or better yet by reversing it, this layer can be eliminated. Furthermore, since its formation is a function of the current density it is possible by controlling it to use higher current densities without "burning" the deposit. Finally, the more even distribution of the deposition is attributed to the fact that the ions, somehow projected toward the cathode by the current pulses, are less sensitive to peak effects.

Gains of Up To 28 Percent on Gold Quantities

Whatever the credit given to these interpretations, the results are there as witnessed by some French users. At the Metal Protection company (Montreuil), the rate of deposition has been increased twofold by using a Polar. For this company which produces thick silver platings (1 mm) on protective plates for electrical switch boxes, a reduction in the deposition time was obviously a prime objective. X-rays also showed a reduction in porosity. According to Gemdata, the gain on deposition rate can be much higher still: up to 600 percent.

But this is not the prime subject of interest for the printed circuit and electrical connectors industry, where most of the trials are being carried out today. The industry hopes to be able to reduce the consumption of gold by reducing the thickness of deposited layer through higher density and a better distribution. Still according to Gemdata, savings of 28 percent on the amount of gold deposited could be achieved just through a better distribution (in the case of a 5-micron deposit on connector contacts).

Although he does not report such spectacular results, Nicolitch, from Draveil, believes he can pay off his Polar equipment within one year, by saving 5 percent on gold consumption, which totals around 35 kg per year. Moreover, the current density has been increased to 2 amps/dm^2 and is limited primarily by the throughput of the robot used to feed the line used for treatment of printed circuit connectors.

Other businessmen in the field of electronics have implemented a more systematic approach to the problem. They are Thermocompact, Souriau, Socapex, and PEM, which have been working for a little over a year in collaboration with the CETIM (Mechanical Industries Technical Center). Their workscope encompasses problems related to nickel layers as well as gold layers, hoping that improvements in the quality of the first (density, brightness) will result in a possibility of reduction in the thickness of the second. The laboratory stage of the "Nickel" part of the study has been practically completed. The CETIM has verified that the hardness of the under-layer has been increased (from 200 to 40 vickers) as well as the density. Furthermore, the deposited layer is semi-bright as a result of the addition of brightness-enhancing materials.

A Manufacturing Secret: the Current Waveform

The translation of these results to an industrial production scale remain to be verified. An important point is: "It is necessary to be certain that when the

thickness of the nickel layer is reduced by taking advantage of the lower porosity, the copper from the under-layer does not diffuse into the gold-layer" stated Mr Francois Mortier of CETIM. The second phase of the program is already started: the question is to find out whether it is possible to reduce the amount of gold per unit area without adversely affecting the properties expected from a connector. This appears probable: According to Eric Robert of Egatec (La Chaux-de-Fonds, Switzerland), who delivered 15 generators to Phillips (Netherlands) the thickness of the gold deposited on transistor leads and printed circuits has been reduced by 20 to 25 percent.

The team effort between CETIM and the industry is significant. Few businesses have the resources in time and money to undertake in-depth studies of phenomena as complex as those involved in pulsating currents. A large number of parameters are involved. The waveform depends upon the metal being deposited, the contents of the bath, and also the geometry of the tank and the distance between anode and cathode. The current profile and the composition of the bath must be studied practically on a case per-case basis. Furthermore, it is not possible to improve all the characteristics of the deposit at the same time, and prudence is in order: "It would be possible to cause the worst catastrophies" stated Christine Mauleon, of Nicolitch. For instance, when the current inversion phase is too significant, we have observed cases of separation of the deposited layer." The end result is that the current waveform used becomes a trade secret and, although it is true that the work of university teams such as the Zurich Polytechnicum is well known, the industry developments, especially in the United States where there are many users, are less well known.

General Scramble Among Equipment Manufacturers

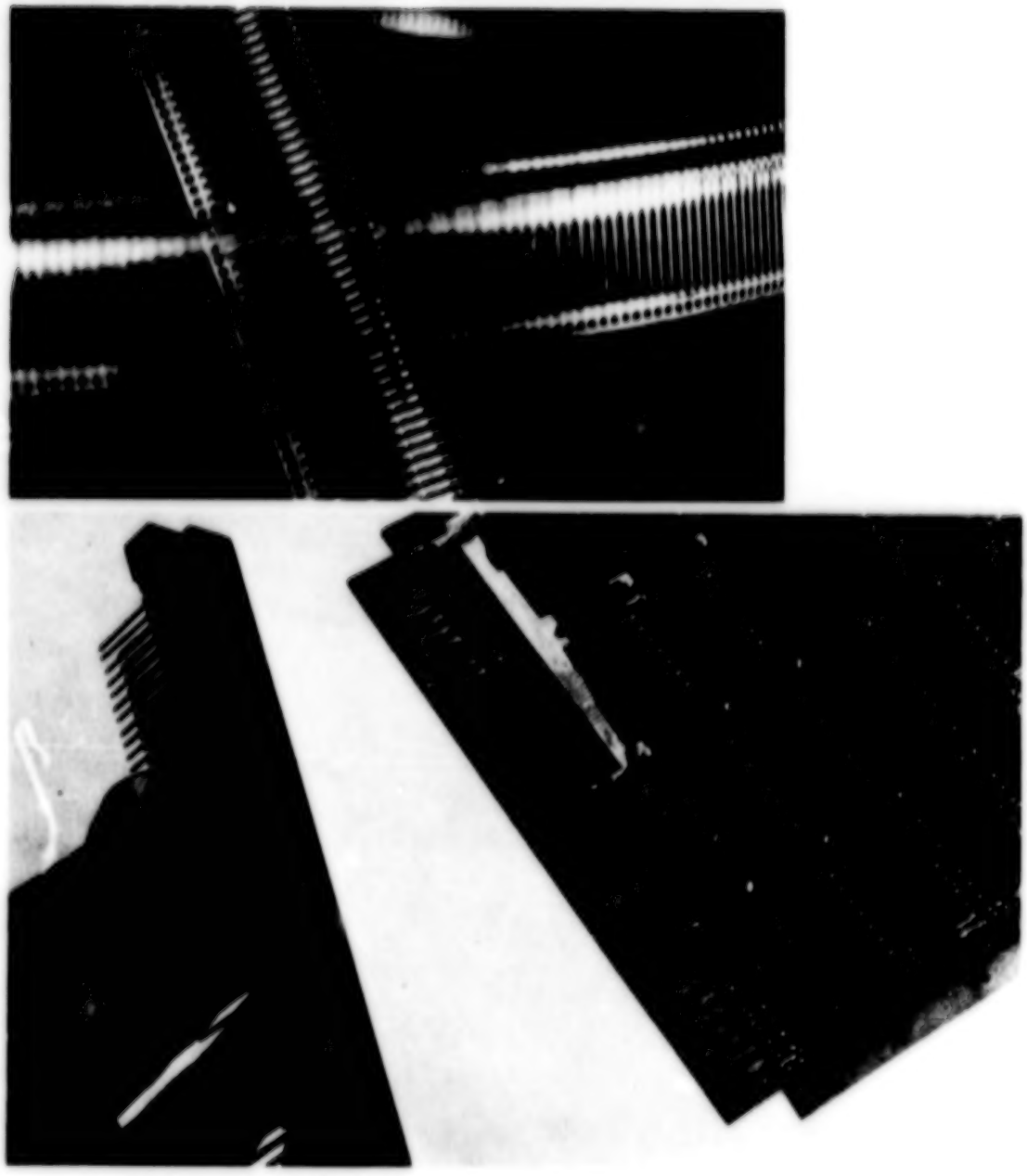
The problem has not been simplified by the newest equipment on the market. This equipment is well ahead of the state-of-the-art in pulsating current electrochemistry. To produce a complex current waveform is easy for the electronics industry, whereas to understand and foresee the practical results is another matter. This is why one must guard against the temptation to forge ahead, warns Eric Robert. "To believe that we can resolve a deposition problem by using a complex waveform would be an error. It is difficult enough to understand what happens with relatively simple waveforms." A manufacturer may be able to guarantee the shape of the current wave that can be seen on the oscilloscope, but he cannot say what results the user will be able to obtain. This lack of knowledge constitutes an impediment to the development of pulsating currents technology.

There is another: with pulsating currents, in order to be able to obtain sufficient current density and average intensity, it is necessary to produce high intensity pulses. This, since currently available materials are capable of producing a maximum of 500 amps peak current, limits applications to the plating of parts with a small area and to precious metals, considering the cost of rectifiers. Generators capable of 1000 amps are expected to be available soon, but in order to reach this level of performance, it will probably be necessary to change the basic concept, and the current waveform will probably not be truly square. This is Eric Robert's opinion who states: "In order to generate square waves, extremely fast current rise times are necessary. This requires using pulse generators providing a switching function as well as a current regulating function," he explains. Equipment of this kind is expensive and consumes a lot of energy, which is not the case

for simple switching devices. In this case, however, the regulation is on the voltage rather than the intensity, and in the case of a 100 microsecond pulse, the current rise time, which may reach 5 to 20 microseconds, is dependent upon the induction of the generator and external circuit. The waveform is no longer square and, at the limit and for high frequencies, it may look like a simple sawtooth wave. Is it absolutely necessary to use square waves? "No," says Eric Robert, "we have obtained very good results using triangular waveforms, although they are not very repetitive and complicate the interpretation of the phenomena."

In any case, the future of pulsating currents seems sufficiently promising to start a scramble among equipment manufacturers. The announcement of Techno-Instruments' Polar generator and its rapid success (more than 10 sold within one year) contributed something to this situation. French manufacturers are also getting involved. Acore is announcing the availability of an instrument within a few months. Some others such as Egatec are adapting their strategy by enlisting chemists in order to be able to offer users a universal process. This is probably a sound approach. Pulsating currents are promoting a simplification of the electrolytic bath contents which, of course, chemists do not like since their job security was resting upon a careful and secret dosage of various ingredients.

[Photos on following page]



Contact strip used in printed circuit connectors (at top); gold-plated printed circuit connector (at bottom). This type of part, with a small surface area and plated with a precious metal, is especially well-suited to treatment by pulsating current.

6445
CSO: 3102/213

BRIEFS

NEW METHOD FOR MAKING COMPOSITES--The British space company H.R.Smith will probably deliver material for a future space station. The firm has developed a new method of manufacturing composite material which will enable enormous structures to be built in space. This breakthrough means that instead of aluminum, composite beams will be used up to 100 meters long. Previously, composite material was made from carbon fiber thermoset plastic, which can not be reworked once it is formed. The problem with that material is not the carbon fiber, but the bonding material which holds it together. With the help of a technique developed by the Royal Aircraft Establishment, Farnborough, a new composite has now been developed which can be reworked in space, which means that the material can be transported more simply, and later can be formed on the construction site in space. Thermoplastics and polyester sulfone are used in the new composite. [Text] [Helsinki PLASTFORUM SCANDINAVIA in Swedish no 3, 1981 p 17] 9287

ELECTRICALLY CONDUCTIVE POLYMERS--Research on electrically conductive polymers is also taking place in West Germany. Since 1979 Stiftung Volkswagenwerk has invested about 12.5 million Swedish kronor in such research under the heading of "Physics and Chemistry of Unconventional Materials." This includes, among other things, the synthesis of conductive polymers, measuring their electrical and magnetic properties, complex of a high degree of purity and theoretical models for certain "organic metals." [Text] [Helsinki PLASTFORUM SCANDINAVIA in Swedish no 3, 1981 p 17] 9287

CSO: 3102

BRIEFS

AIRBUS PARTS FROM ITALY--Aeritalia and Deutsche Airbus, which represents the FRG firms within the framework of the Airbus program, have finalized a framework agreement for allotting the contracts to be awarded to the Italian aeronautical industry. Within the framework of the agreement, Aeritalia represents the major Italian industries in the sector. Consequently, MBB [Messerschmitt-Boelkow-Boehm], which is a participant in Deutsche Airbus, has given its own consent to startup of production of components; the tail cone and the fairing for the new Airbus A310's and for the advanced version (600 series) of the Airbus A300B will be produced in Italy. This contract represents about 250,000 work hours per year for the Italian aeronautical industry. The work will be done by a group of Italian firms under the coordination of Aeritalia. Further negotiations for the allotment of other bus-contracts are also under way. [Text] [Rome AVIAZIONE in Italian Feb 81 p 26] 11267

CSO: 3102/184

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May 7, 1981